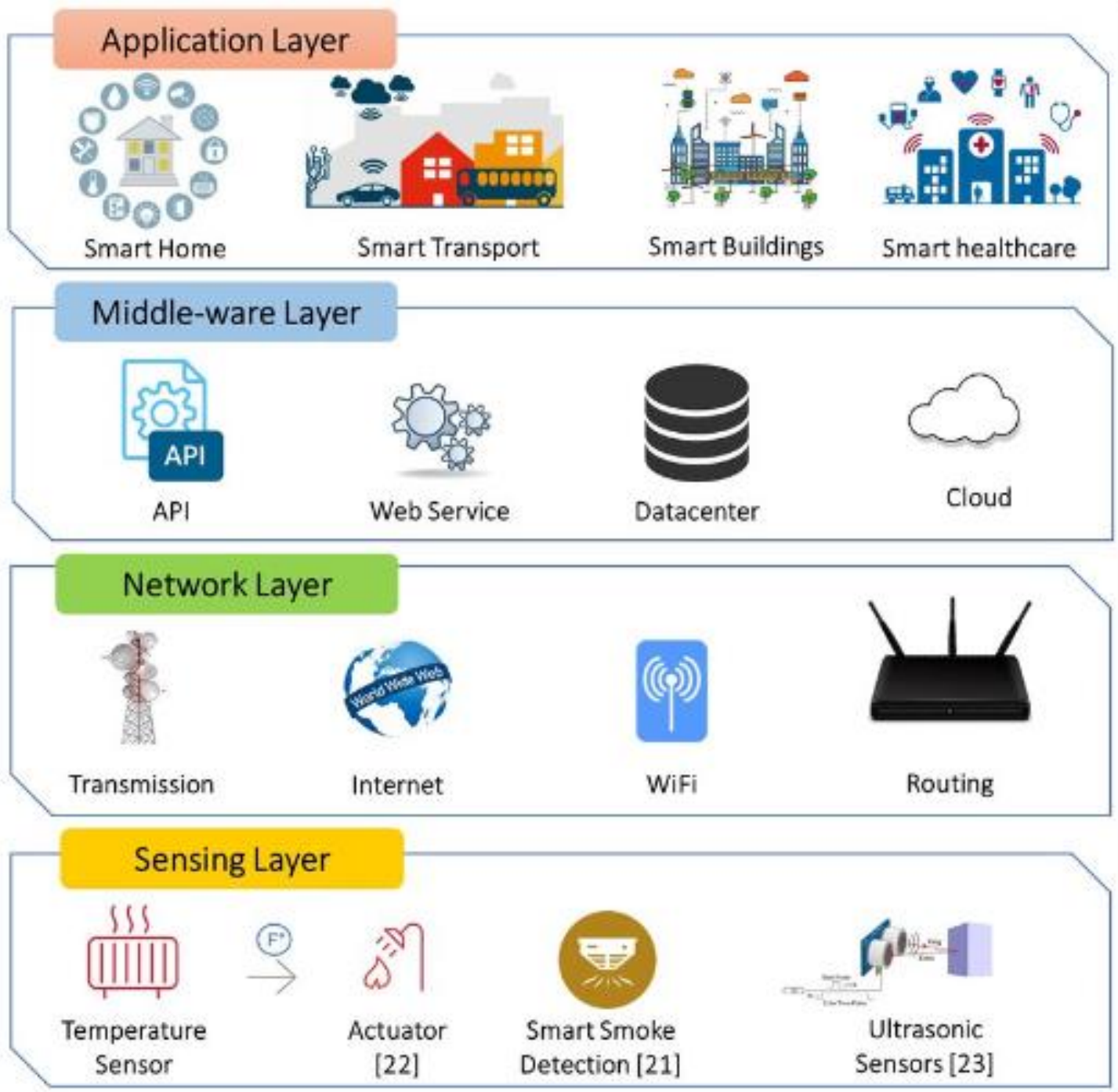
Ch:03

Emergence of IoT:

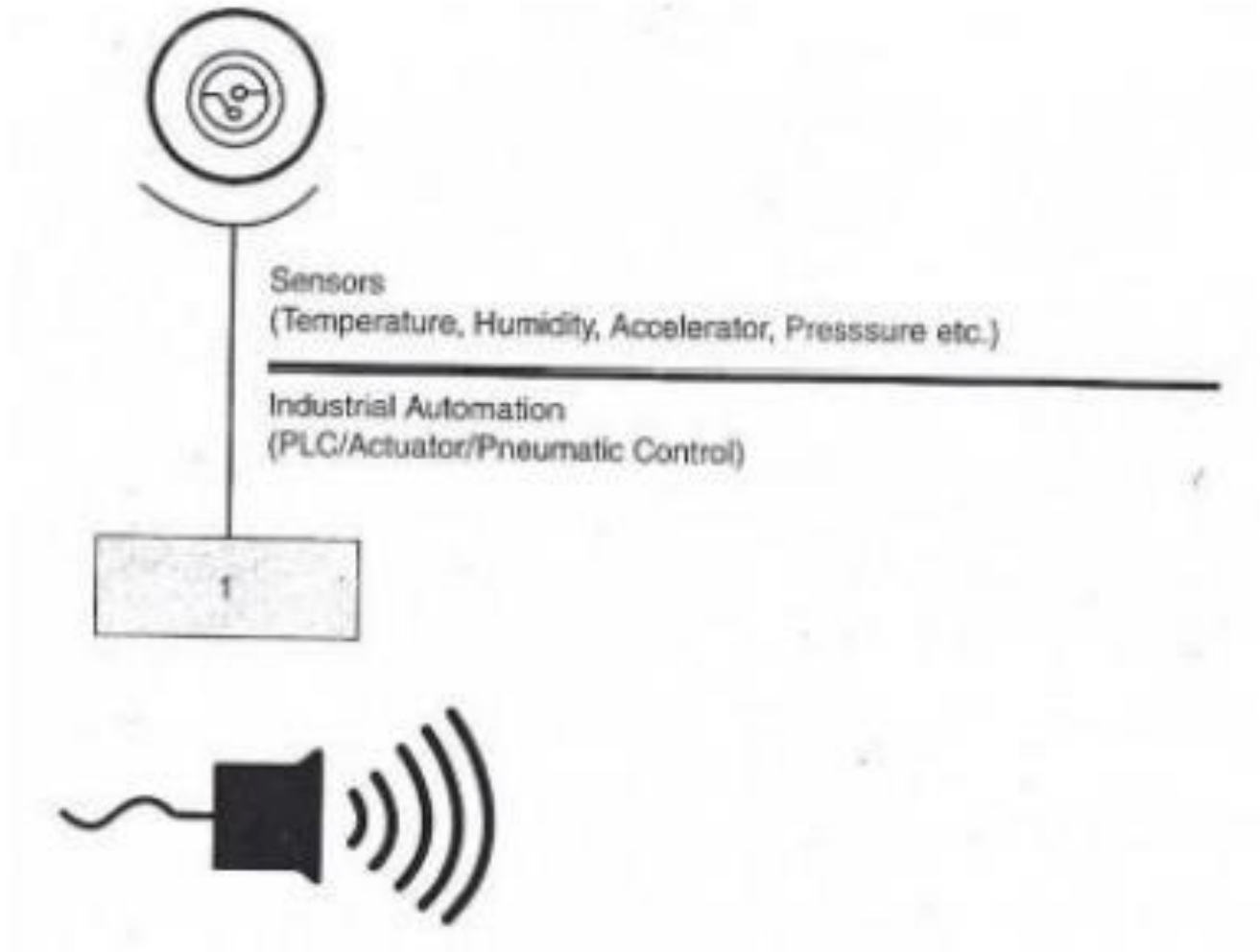
- IoT Growth- A statistical View,
- Application area of IoT,
- Characteristics of IoT,
- Things in IoT,
- IoT stack,
- Enabling Technologies, IoT challenges,
- IoT levels,
- Cyber physical systems versus IoT,
- Wireless sensor Network with IoT

- As with any other digital technology, IoT has a stack with clearly defined layers.
- Before discussing IoT stack, let us first recall the Open System Interconnection (OSI) layer.
- OSI model defines a networking framework to implement protocols in seven layers, where Layer 1 is the physical layer and layer 7 is the application layer.
- Each layer has the protocols defined clearly with appropriate hardware/software working from it.
- We have identified the following seven layers in IoT stack


Application Layer
Smart Home
Smart Transport
Smart Buildings
Smart healthcare
Middle-ware Layer
API
API
Web Service
Datacenter
Cloud
Network Layer
Transmission
Internet
WiFi
Routing
Sensing Layer
Temperature Sensor
Actuator [22]
Smart Smoke Detection [21]
Ultrasonic Sensors [23]

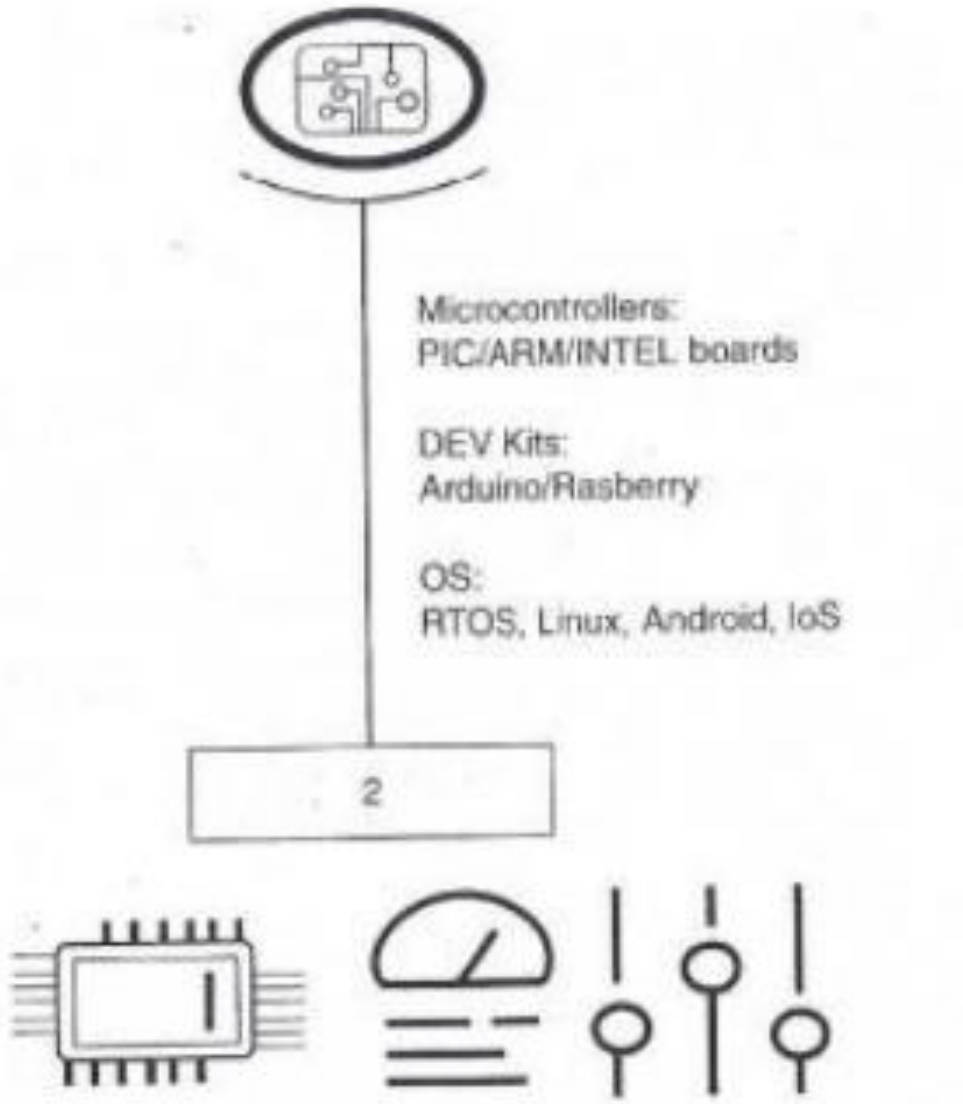
1. Layer 1 (Physical or sensor layer):

- This layer is concerned about the physical components, which mainly includes sensors.
- In this layer, the sensors are the core component.
- Temperature sensor, pressure sensor, humidity sensor, etc. can all be referred to as physical layer components.
- While considering industrial automation, PLC, actuator, etc. are regarded as physical layer components.
- This layer is responsible for data collection (i.e., sensing happens here).
- Choosing an appropriate sensor is the challenge in this layer since there are many sensors available in the market that capable of performing the same tasks but at different costs. Hence, the selection of sensors is important.


Sensors
(Temperature, Humidity, Accelerator, Presssure etc.)
Industrial Automation
(PLC/Actuator/Pneumatic Control)
1

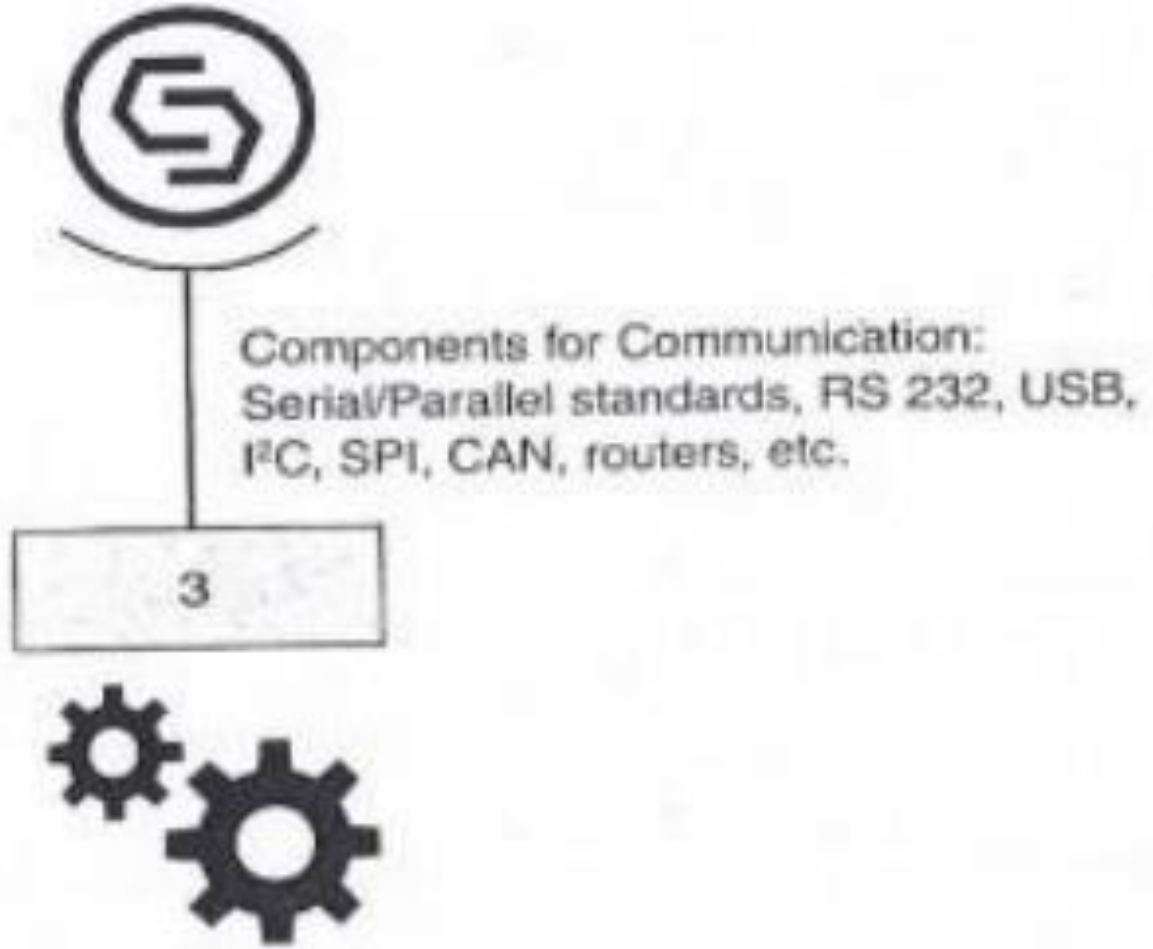
2. Layer 2 (Processing and control action layer):

- This layer is very significant; it comprises of the core components for IoT.
- The microcontrollers or processors are found in this layer,
- the data is received by the microcontrollers from the sensors.
- A variety of development kits are available in the market; one can easily spot Arduino, NodeMCU, PIC, ARM development boards.
- Operating systems play a major role too and Android, IOS, Linux can very well execute the task.
- The data collected from the sensors is processed in this layer.
- To determine if the data is meaningful a microcontroller should be present.


Microcontrollers:
PIC/ARM/INTEL boards
DEV Kits:
Arduino/Rasberry
OS:
RTOS, Linux, Android, IoS
2
1

3. Layer 3 (Hardware interface layer):

- The next layer in the stack is the hardware interface layer.
- The hardware components and communication standards such as RS232, CAN, SPI, SCI, PC, etc. occupy this layer.
- All these components ensure flawless communication


Components for Communication:
Serial/Parallel standards, RS 232, USB,
I²C, SPI, CAN, routers, etc.
3

4. Layer 4 (RF layer):

- It plays a major role in the communication channel - be it short range or long range.
- The protocols used for communication and transport of data based on RF are listed in this layer.
- Some famous and common protocols are Wi-Fi, NFC, RFID, Bluetooth, etc.
- This layer can also include Li-Fi (not dependent on RF); which are effective alternates for RF protocols.

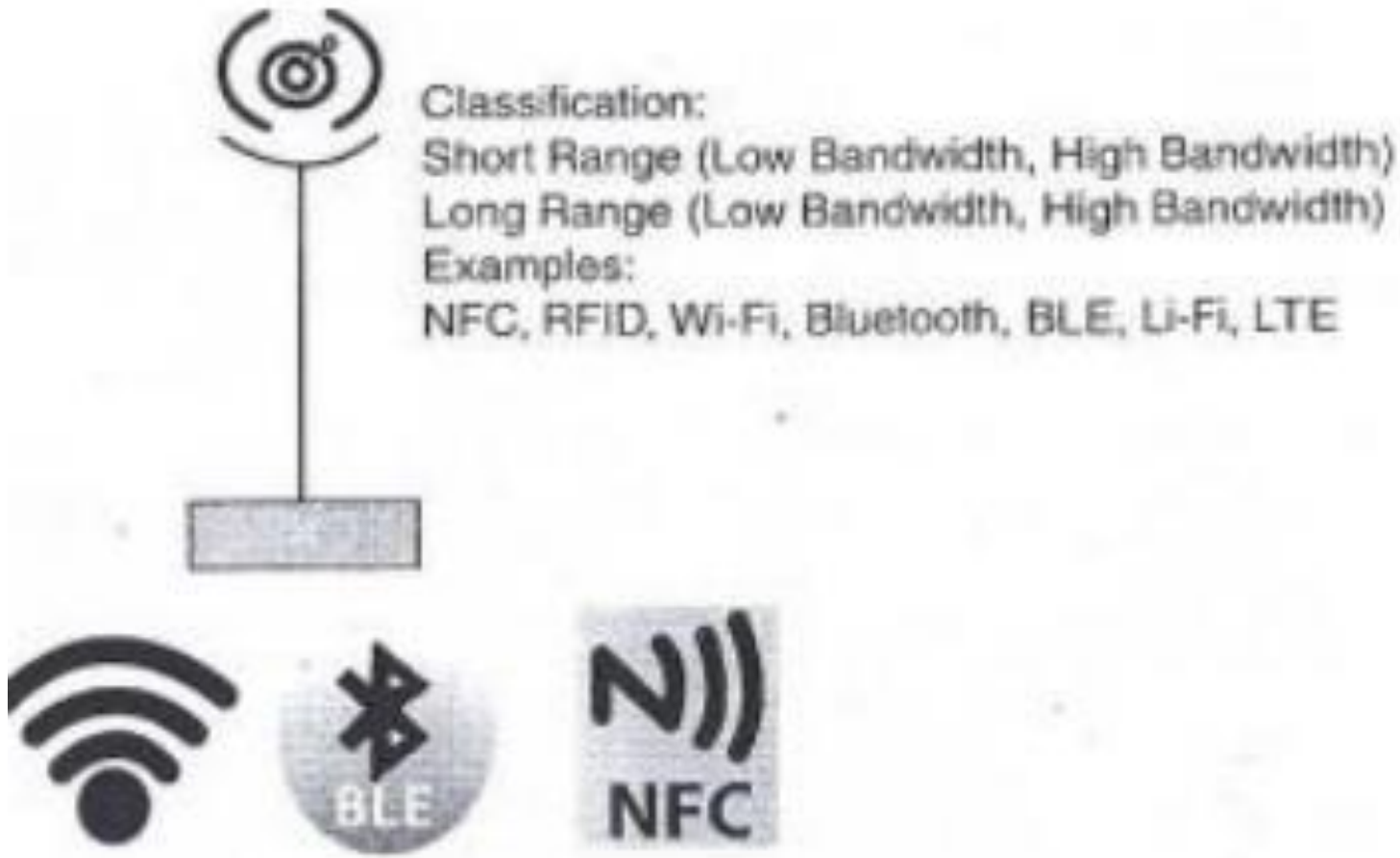
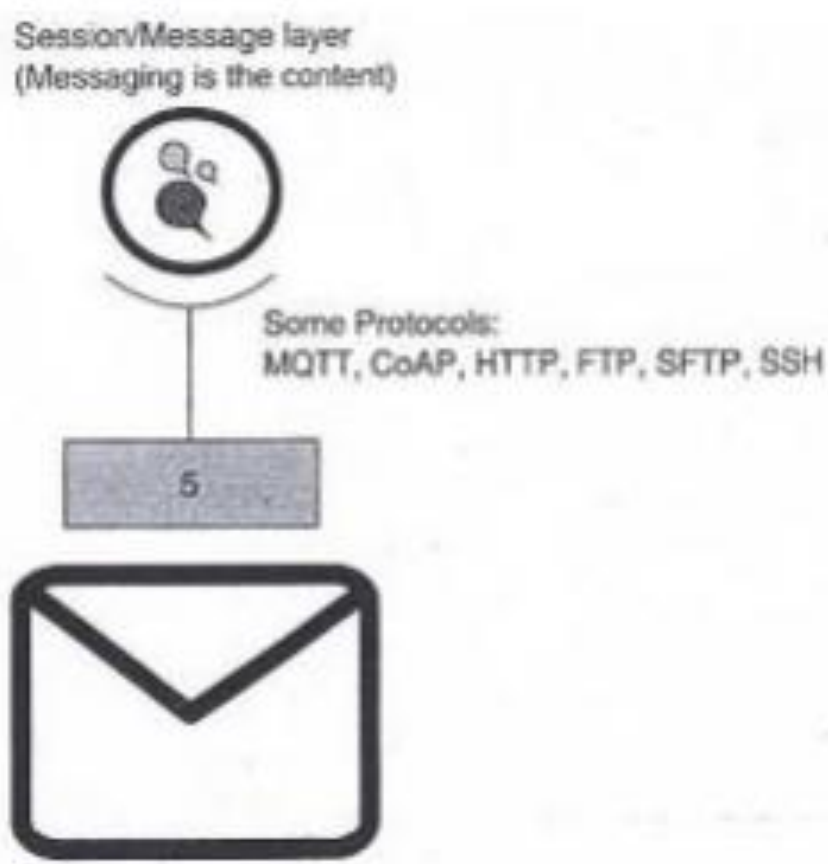


Figure 1.11 Layer 4 : RF layer

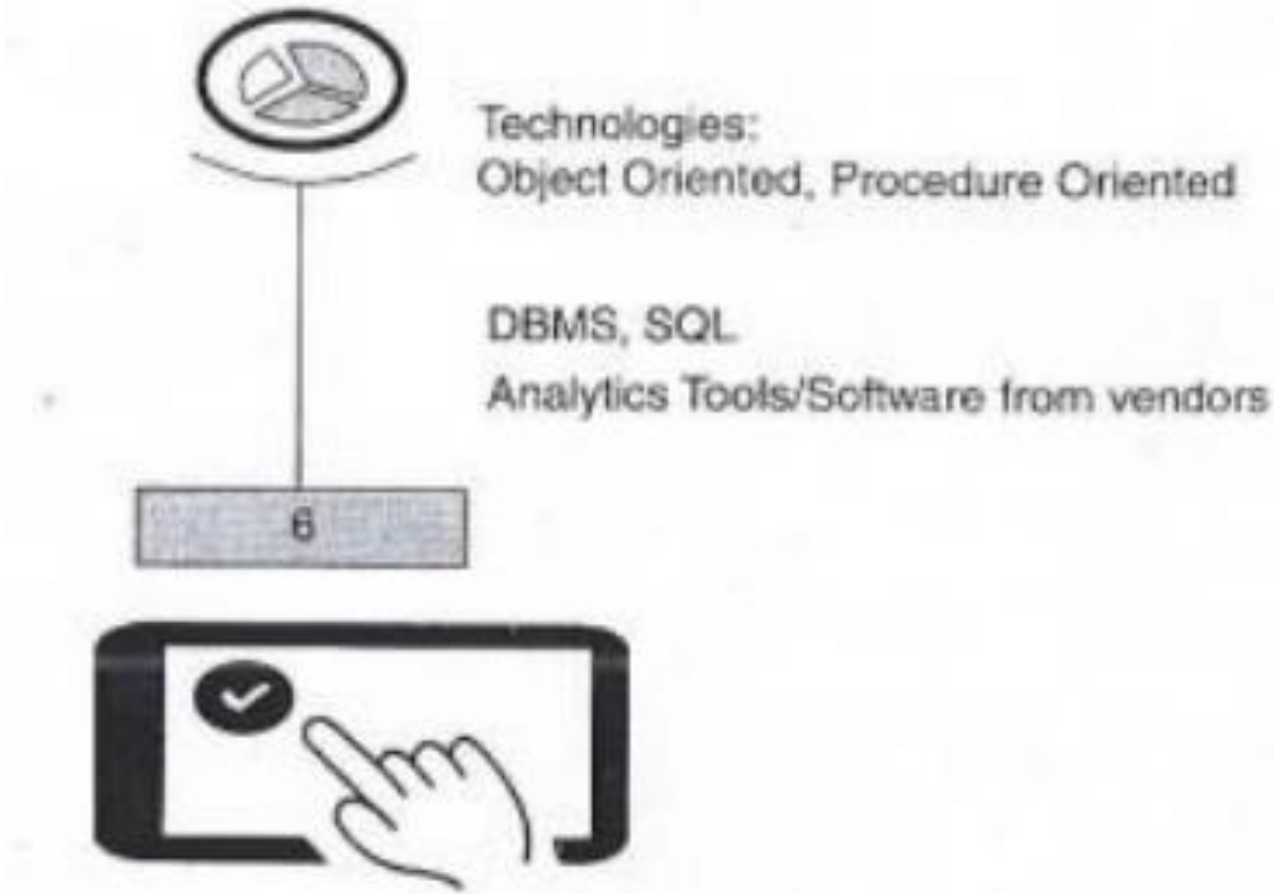
5. Layer 5 (Session/Message layer):

- Session management is as important in IoT as it is in general networking, which is guided by OSI layer.
- There are protocols which oversee how messages (data) are broadcasted to the cloud.
- Layer 5 (session layer) has the messaging protocols as MQTT, CoAP, etc. and also other protocols such as SSH and FTP .


Session/Message layer
(Messaging is the content)
Some Protocols:
MQTT, CoAP, HTTP, FTP, SFTP, SSH
5

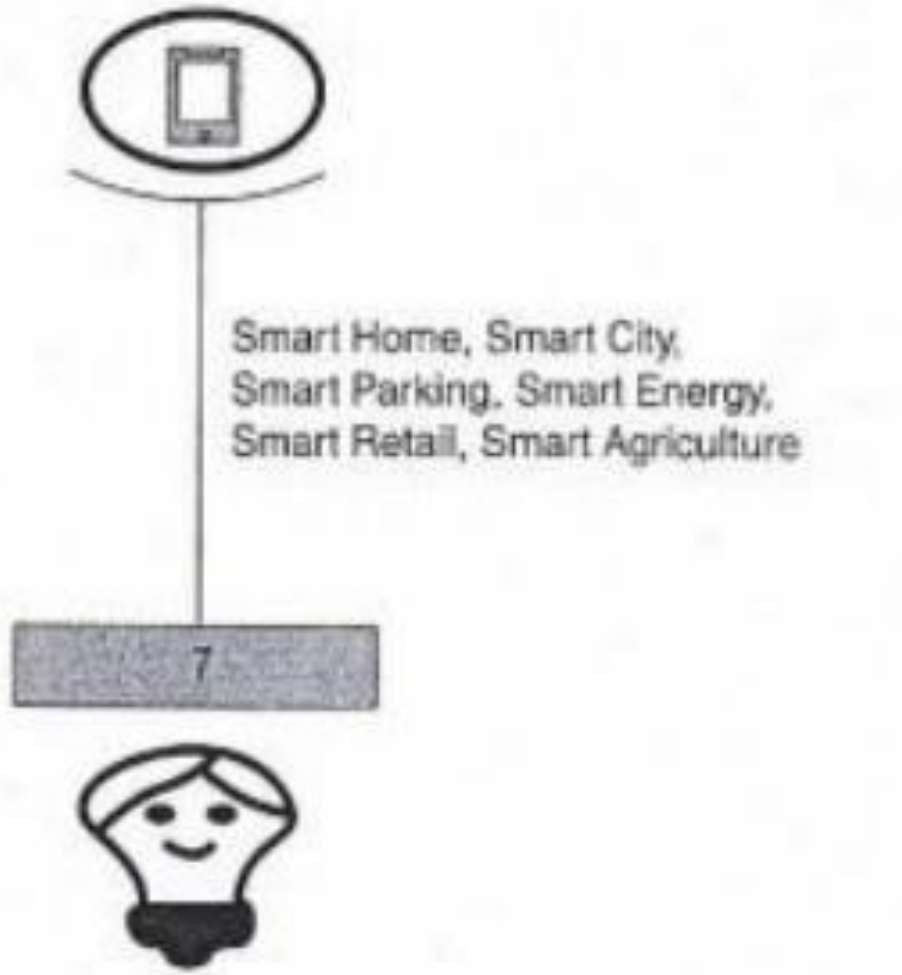
6. Layer 6 (User experience layer):

- This layer is fully concerned with the end user experience .
- When a product is designed, it should showcase rich UI features and designs which provide a pleasing experience while using the service/system or product.
- Object-oriented programming languages, scripting languages, analytics tools, etc. all should be included in this layer.


Technologies:
Object Oriented, Procedure Oriented
DBMS, SQL
Analytics Tools/Software from vendors
6

7. Layer 7 (Application layer):

- Everything comes to perfection at this layer.
- This layer talks about the possible applications that can be built with the support of the rest of the layers.
- It can range from a simple automation application to smart city application.


Smart Home, Smart City,
Smart Parking, Smart Energy,
Smart Retail, Smart Agriculture
7

Vegetable quality monitoring during transport from source to the destination using IoT

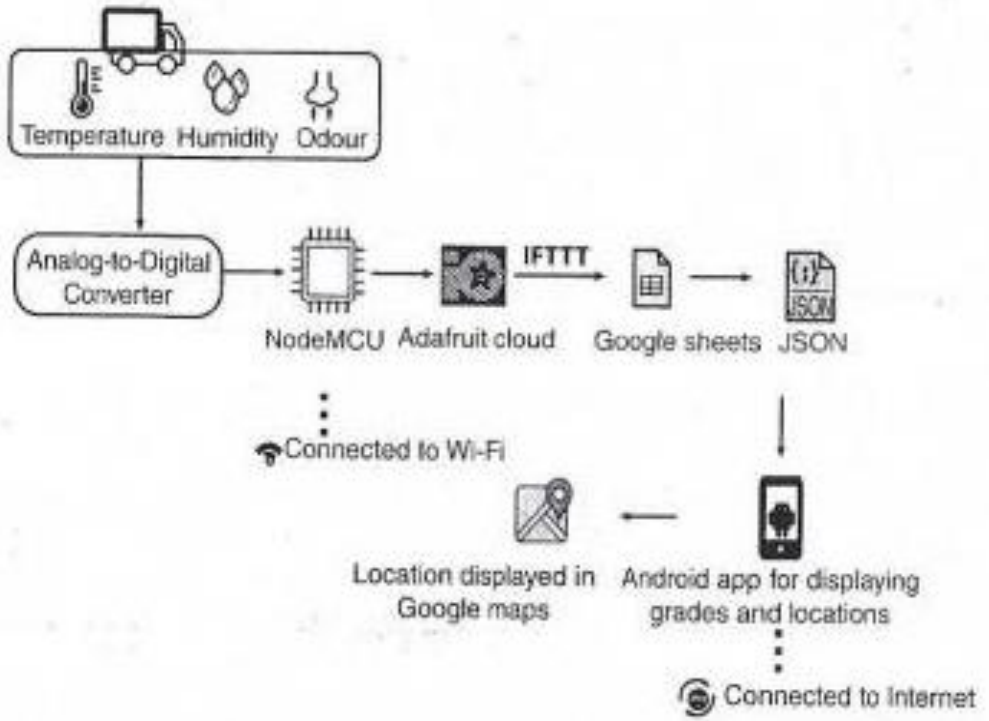


Figure 1.15 Architecture of a smart vegetable quality tracking system using IoT

- In this application, you will be able to identify all the above-mentioned layers.
- To set the tempo, the architecture diagram of the smart vegetable quality tracking application for transport is presented in Fig.
- One can understand that it starts with the sensor layer, where temperature, humidity, etc. are measured.
- Then the data goes to the microcontroller; from there it goes to the cloud (Adafruit) and here the messaging protocols take effect.
- Adafruit is the cloud storage platform used in this application.
- RF protocols such as Wi-Fi are used for transport and communication. User experience is taken care with the Android application designed.

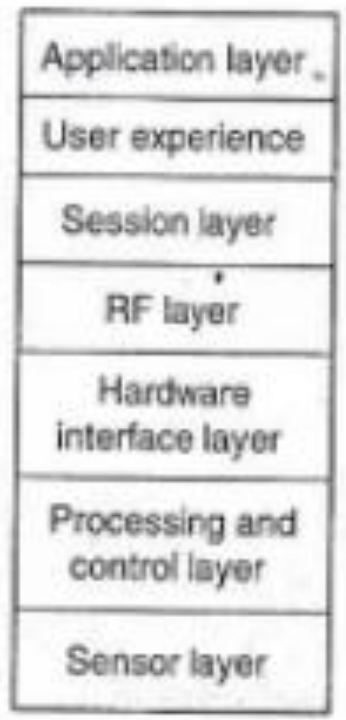


Figure 1.16 IoT layers

Thank you